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The Telegraphic Journal.

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THE COMPLIMENTS OF THE SEASON.

WE commence the new year with a new volume, and in wishing our readers all the compliments of the season we trust they will reciprocate that feeling by wishing us continued success in the publication of this Journal. That there is a large field for a technical periodical like this is not only evident from the wide and extensive range of telegraphic enterprise, but from the marvellous success of the Society of Telegraph Engineers. In three years that Society has sprung from a small coterie to a large and influential body of over 600 members, embracing all our leading electricians and telegraphists. Its past President is the first English Electrician of the day; its present President is the first Telegraph Engineer; its Council is composed of our leading men in the profession; its Members are spread over the whole face of the Globe, and its Proceedings form probably the most valuable records that have ever been published on telegraphic and kindred subjects. Though telegraphists are knitted together by wires which render them independent of the geographical resistance of seas, mountains, and rivers, and they are practically independent of space, nevertheless these bonds of communication are beyond their reach for purposes of instruction, discussion, and investigation. This can only be done by the time-honoured post. It is this function which this Journal is especially designed to fulfil. Its pages will contain contemporary history of all that is going on and being done in different countries. Elementary papers on various points connected with the technical branch of the profession will be continued; its columns will be open to discussion, and will form a medium for enquiry and investigation. The Society of Telegraph Engineers is the proper receptacle for original communications upon the results of investigation and research. It is hoped that the Members of that Society and the readers of this Journal will not fail to make use of those observant and reasoning powers with which they have been blessed to advance their profession and improve their own knowledge, by adding some little mite to the general stock of Telegraphic Science. The advance of Science is made by slow and short steps, such steps being the result of observation tested by experiment and confirmed by reason. If its progress were dependent upon one or two thoughtful observers its rate of progress would be slow indeed; but if the observers be multiplied and scattered, and if their observations be recorded and distributed, then its rate of progress will be considerably expedited. This, in fact, is the reason why Telegraphic Science has made such giant strides, and it is to continue this good work that our little Journal is framed into another volume and is launched into another year.

TELEGRAPHY IN 1874.

OF the progress of telegraphy in 1874 the principal portion appears to be that of the various Submarine Extensions, which have not only been numerous, but also important; South America having been brought into almost direct communication with Great Britain during the year.

In 1873 the section of the Brazilian Company's system from Lisbon to Madeira was partially laid, but, owing to the appearance of a fault, the work was stopped until the present year. On the completion of the section between Madeira and St. Vincent—a length of 1200 nautical miles—the broken cable off Madeira was recovered, and communication thus was established between Lisbon and St. Vincent. Subsequently the section between St. Vincent and Pernambuco—1845 nautical miles—was completed, and thus, by means of the Eastern Company's cable from Lisbon, was the Brazils brought into direct telegraphic communication with the United Kingdom. Consequently, upon the laying of the various cables belonging to the Western and Brazilian, the Central American, and others, communication was opened up between Demerara on the North and the River Plate on the South.

The Anglo-American Company succeeded in laying a fifth cable across the Atlantic, by means

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of the cable left from last year, and a subsequent addition of 1100 miles of new cable. The *Great Eastern* was occupied in the work, and difficulties were encountered, as the weather was most severe. It is difficult to understand the operations of the Company, for they have gone to the expense of laying an entirely new cable, whilst they appear to abandon an existing cable (1865) which has been broken down.

An attempt has been made, by an opposition Company, to lay a separate and independent cable across the Atlantic. This has so far succeeded that the cable has been submerged across to within a short distance of Newfoundland, and there buoyed. It appears, however, to have a fault in it. Bad weather has for some weeks prevented any operation, so that the Direct United States Company have been unable to complete their communication during the present year.

Cables have been laid during the year between Jamaica and Porto Rico, and another short West Indian section, also between Constantinople and Odessa, between Zante and Otranto, and between Barcelona and Marseilles. The amount of mileage added to the submarine system has been very great, exceeding that of any previous year.

Accidents have been not infrequent, both at home and abroad, but from the rapidity of the repairs—showing the value of local repairing steamers—the interruptions have not extended over any great period.

Numbers of the Post-Office cables have been broken, but, with the exception of the English-Guernsey cable (broken for the second time), all have been restored. In the repairs to the Irish cable it was noticed that the hemp and gutta-percha had suffered very much from the appearance of several distinct kinds of "boring" worms, which had done much damage,—especially one kind, which attacked and penetrated the gutta-percha to so great an extent that a fault had occurred. These worms were noticed in the Wexford, as well as in the Holyhead and Dublin cable.

The Postal Telegraph Department have during the year introduced the Sounder as much as possible, and it may now be definitely considered as the instrument of the future: its various advantages have at last become apparent, and in time we shall observe its use as wide and extended as may be seen in the United States.

The Duplex continues to advance, and the Stearns's system is rapidly becoming extended. The advantages derived from the system of duplex working have daily become more and more apparent.

The important work of the transfer of the Postal Telegraph system from the old centre at Telegraph Street to the new buildings in St. Martin's Lane was most successfully accomplished during the first week of the year, reflecting the greatest possible credit upon those engaged.

DR. GLADSTONE'S LECTURES AT THE ROYAL INSTITUTION.

Dr. Gladstone, F.R.S., Fullerian Professor of Chemistry, commenced, on December 29th, a course of six lectures on the Voltaic Battery. Though they are adapted to a juvenile auditory, there can be no doubt that they are equally adapted to a large majority of our readers. We have much pleasure in announcing that the learned Professor has kindly consented to allow a verbatim report of these lectures to appear in these columns. The first lecture, on "The Cell and its Effects," will appear in our next. Junior telegraphists will do well to follow these lectures closely, and to repeat the experiments described in them. There is a great tendency to be contented with the description of an experiment, but students who really desire to learn should never be satisfied until they have made the experiment for themselves. It is the only way to acquire a knowledge of Electricity.

THE LATE REV. HENRY HIGHTON.

We have to record the very sudden decease, at his residence in The Cedars, Putney, of the Rev. Henry Highton, a gentleman long and well known in scientific, telegraphic, and scholastic circles. He was for many years one of the assistant masters of Rugby School, and afterwards for some time the principal of Cheltenham College. Mr. H. Highton was educated at Rugby under Dr. Arnold, of whom he was a favourite pupil, and between whom and himself there existed a strong personal attachment. Dr. Arnold, indeed, has left it on record, in a formal testimonial given shortly before his lamented death, that Mr. H. Highton was one of the best pupils who ever passed through his hands. As head of the school, and afterwards as one of its masters, Mr. H. Highton attained a lasting popularity, and in his shorter career as principal of Cheltenham he secured the attachment and respect of all the senior pupils. As a scientific man he is associated with various discoveries in connection with electrical telegraphy, for which he more than once received a medal from the Society of Arts. He took out his first patent as early as July, 1844, for a telegraph worked by static electricity and a chemical recorder. In 1846 he invented his well-known gold-leaf telegraph, which, however, was never practically used. A small strip of gold leaf inserted in a glass tube was made to form part of the line circuit, and it was placed between the poles of a large permanent magnet. Whenever the line currents passed through the gold leaf it was instantly moved to the right or left, according to the direction of the current. Its delicacy is so great that efforts have been recently made to introduce it upon our long-cable circuits. In 1848 he took out a patent, with his brother Edward, for a new form of needle telegraph, and various other modifications; and in 1850 the British Electric Telegraph Company was formed for the express purpose of working and bringing into more general use the inventions of Messrs. H. and E. Highton. He recently (1872-3) introduced a new form of battery, and has been engaged in perfecting a mode of working long submarine cables by means of his gold-leaf receiver, and a new electro-magnetic induction apparatus, by which the sensitiveness of telegraph instruments is considerably increased. He also, some years ago, invented and perfected a new kind of artificial stone, now largely used for paving and building purposes. Mr. H. Highton was formerly elected a Mitchell Fellow of Queen's College, Oxford, after highly distinguishing himself in both the classical and

mathematical class lists of that University. He was a candidate for the Head Mastership of Rugby at the period of Dr. Hayman's election.

ON DIRECT AND INDIRECT DETERMINATION OF THE POLES IN MAGNETS.

By TH. PETRUSCHEVSKY.

THE author gives the name absolute pole to the point upon which the parallel magnetic forces are directed. By relative pole he means the point where centre the resultants of magnetic forces not in parallel directions. If the word pole is used by itself, the absolute is implied in the absence of direct intimation to the contrary. As the most intense magnetic forces are concentrated in two small spaces near the ends of the magnet, they may be considered as parallel in relation to an external point proportionally near the magnet, and exposed to its action.

First Method for the Direct Determination of the Poles.—Let N O S (Fig. 1) represent the horizontal projection of a magnet, suspended from a point situate in the middle between N and S. Let the line M M' be parallel to N S, and let both lie in one horizontal plane. Along the line M M, let small magnets, perpendicular to this line, and at the same time horizontal, be moved. These I call the needles. Let us first consider the action of the needle m upon the pole N, in the supposition that the distance N m is sufficiently great to allow of the pole N being regarded as absolute.

FIG. 1.

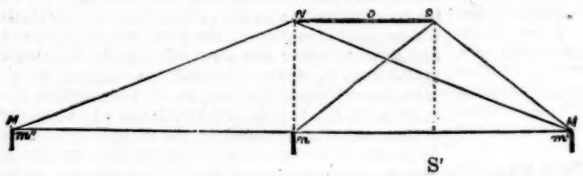
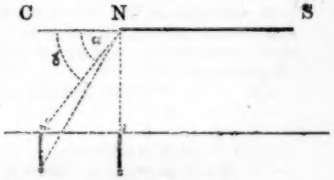


FIG. 2.



It may then be readily shown that the mutual action which the point N and the needle m exert upon each other, attains its maximum when m stands exactly opposite to the pole N. In any position whatever (Fig. 2) of the needle, n' s', its action, T, upon the pole, N, may be expressed by the equation

$$T = p\left(\frac{\sin^3 \alpha}{n\,N^2} - \frac{\sin^3(\alpha+\gamma)}{s\,N^2}\right)$$

p signifies a constant depending on the intensity of the magnet, N S, and of the needle; α, on the other hand, and $\beta = \alpha + \gamma$ the angle C N n' and C N s'. If we now, without regarding the physical signification of the assumption, put $\gamma = 0$, the value of T evidently increases, so that

$$\sin^3\alpha\left(\frac{1}{n\,N^2} - \frac{1}{s\,N^2}\right) < \left(\frac{1}{n\,N^2} - \frac{1}{s\,N^2}\right)$$

that is on the supposition that $\gamma = 0$, the action of the needle, n s, upon the pole, N, is smaller than the last expression, and hence it must, *a fortiori*, be the full value of T. Let m (Fig. 1) be at the least distance from the pole, N. If beside its action there were no other, the position of the pole would be simply determined by the intersection of the produced needle, m, with the magnet, N S. But the action of the S pole upon the needle, m, modifies the above result, and we shall now, instead of this disturbing action, introduce one equal, but opposite. For this purpose a second needle, m', is introduced in the opposite direction to the former m, so that the one attracts the S pole whilst the other repels it. Both actions annul each other as soon as S m = S m', and the magnetic momenta of the two needles, m and m', are equal. There remains then the action of the needle m upon the pole N, which can be compensated by a third magnet, m'', which is placed in the opposite direction to the second, and for which N m'' = N m'. We will be satisfied with three needles, and assume that when moved they satisfy the above-mentioned conditions, *i.e.*, that on displacement of the needle, m, both the others move in such a manner that m S remains equal to m' S, and likewise m'' N = m' N. If these conditions are satisfied, we may limit our consideration to the action of the needle m upon the pole N, and the problem is thus solved. The above-mentioned conditions involve that the movements of the needles m and m'' are always alike, but those of m and m' are opposite in direction. The speed of motion for all three magnets must be equal.

The movements required by these conditions can be secured by a screw which has at its two ends equal but opposite threads.

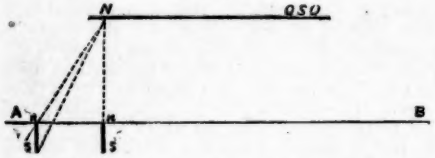
The position of the needles m, m', and m'', is arranged at first approximately, and so that the middle of the distance, m m', arbitrarily selected lies opposite to the point S, which is also approximately determined according to the considerations of Coulomb. We assume, firstly, the distance of the point S' from the end of the magnet at 25 to 35 m.m., according to the size of the magnet, and commence thus the measurement. We determine first the position of the pole N, moving the system of needles till the greatest action is attained between m and N. The position of the pole S is then determined. If this latter determination deviates much from the assumption made at the commencement, the determination of N must be repeated, the position last found for S being retained.

After some observations made by this method, I gave it up, and replaced it by a more simple process.

Second Method for the Direct Determination of the Poles.—Let the position of one pole, S, be known; let the magnet be suspended by this pole, and kept in equilibrium horizontally by a counterpoise (Fig. 3); let a small magnet, n s, move in this horizontal plane, in the direction A B parallel to N S, whereby it remains constantly perpendicular to A B. If the point of suspension of the magnet coincides exactly with the pole S, the

determination of the other pole, whose position we assume as unsymmetrical, is very simple. For this purpose, as in the first method, we have to find that position of the needle, $n\ s$, with respect to A B, in which its action upon the magnet, N S, attains its maximum value. The point of intersection of

Fig. 3.



the produced needle with the main magnet is then the pole sought for. In general, however, the pole S does not coincide exactly with the point of suspension Q, as it has been only approximately determined by the experiments of Coulomb; hence the needle, $n\ s$, has a greater or smaller action also upon the shorter arm of the magnet. The question is now under what conditions the displacement of the needle, $n\ s$, is accompanied by such changes in the reciprocal action between it and the magnet under examination, as are exclusively produced by the action of the needle, $n\ s$, upon the pole, N.

Let 2 L signify the distance between the poles N and S.

$\pm \delta$ L that between the pole S and the point of approximation.

D that between the lines N S and A B.

Z that of the needle $s'\ n'$ from the point of its maximum action (*i.e.*, $Z = n\ n'$).

l the distance between the two poles of the needle, $n\ s$.

The action of the needle, $n\ s$, upon the pole, N, is then—

$$k = \left(\frac{\cos n'\,N\,n}{n'\,N^3} - \frac{\cos s'\,N\,s}{s'\,N^3}\right)(2\,L \pm \delta\,L) = \left(\frac{D}{n'\,N^3} - \frac{D+l}{s'\,N^3}\right)2\,L \pm \delta\,L).$$

But as—

$n'\,N^3 = (D^2 + z^2)^{\frac{3}{2}}$ and $s'\,N^3 = [(D+l)^2 + z^2]^{\frac{3}{2}}$,

therefore—

$$k = (2\,L \pm \delta\,L)\left(\frac{D}{(D^2+z)^2]^{\frac{3}{2}}} - \frac{D+l}{[(D+l)^2 + (2\,L+z)^2]^{\frac{3}{2}}}\right).$$

In like manner we find the momentum of torsion in the action of the needle, $n'\ s'$, upon the pole S. If we put it $= F$, then

$$F = \delta\,L\left(\frac{D}{[D^2 + (2\,L + z,^2]^{\frac{3}{2}}} - \frac{D+l}{[(D+l)^2 + (2\,L+z)^2]^{\frac{3}{2}}}\right).$$

In order that in a displacement of $n'\ s'$ the alteration of k thus produced may be greater than that of F, the condition $\frac{d\,k}{d\,F} > 1$ must be kept in view, since then the changes in the position of the magnet under examination must be chiefly ascribed to the action of $n\ s$ upon N.

But now—

$$\frac{d\,k}{d\,F} = \frac{2\,L \pm \delta\,L}{\delta\,L} \cdot \frac{z}{2\,L \pm z} \cdot \frac{\frac{D+l}{[(D+l)^2+z^2]^{\frac{3}{2}}} - \frac{D}{(D^2+z^2)^{\frac{3}{2}}}}{\frac{D+l}{[(D+l)^2+(2\,L+z)^2]^{\frac{3}{2}}} - \frac{D}{[D^2+(2\,L+z)^2]^{\frac{3}{2}}}};$$

or, finally—

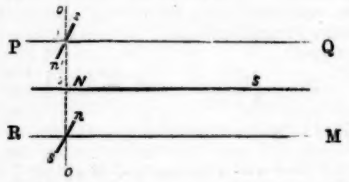
$$\frac{2\,L \pm \delta\,L'}{\delta\,L} > \frac{2\,L \pm z}{z} \cdot \frac{\frac{D+l}{[(2\,L+z)^2+(D+l)^2]^{\frac{3}{2}}} - \frac{D}{[(2\,L+z)^2 \cdot D^2]^{\frac{3}{2}}}}{\frac{D+l}{[z^2+(D+l)^2]^{\frac{3}{2}}} - \frac{D}{[z^2+D^2]^{\frac{3}{2}}}}.$$

If in the last expression we insert, instead of the symbols, the numerical values, as experimentally determined, we may convince ourselves as to whether the condition has been fulfilled or not. In the latter case the values of D and l have to be altered till the numbers suit the formula. To be finally satisfied as to the accuracy of the determination of the position of the pole, we may proceed as follows:—After the one pole, *e.g.* N, has been ascertained as above directed, the magnet is reversed, and suspended by its N pole, whilst the position of the S pole is determined, The magnet is then again suspended by the S pole, but more accurately than before, and the position of the N pole is once more determined. Experiment shows that the result of the second determination differs from that of the first within the limits of errors of observations. This method, as well as the previous one, renders it practicable to determine the position of the poles even when they are not symmetrically distributed.

Before describing the apparatus used for determining the poles, I will point out certain sources of error which may possibly occur.

(*a*). The needle must, when displaced, always be set vertically, both to the direction of displacement, R M, and to the axis of the magnet, N S. From

Fig. 4.

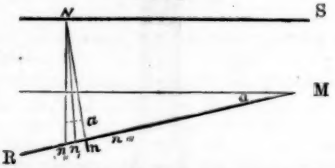


any deviation of the needle from the perpendicular there results an error in the determination of the pole, which, however, can be eliminated by means of two observations—in one of these the needle lies the right, and in the other to the left of the magnet. In Fig. 4, N S is the suspended magnet, P Q and R M two lines equidistant from and parallel with NS. Let $n\ s$ be the position of the needle in the first observation, $n'\ s'$ in the second; further, let the line o N o' pass through the N pole, and be perpendicular to the three parallel lines. In the first position the N pole falls on the one side of the

line $o\ o'$, and in the second position on the other. If we assume, as is warranted by the construction of the apparatus, that the two directions $n\ s$ and $n'\ s'$ are parallel, it follows that if the first determination of the pole gives a positive error, that in the second determination must be negative. According to the one measurement the distance of the pole from the extremity of the magnet is $R + p$, according to the other $R - p$. Half the sum of the two $= R$ is therefore free from the error in question.

(*b*). Let the needle be fixed perpendicular to its direction of displacement, R M (Fig. 5); let

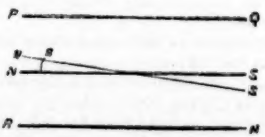
FIG. 5.



this not be parallel to N S, but situate in the same plane with it; let m be the position of the needle in the case when its production touches the pole N; let n N not be perpendicular to N S. A removal of the needle towards n' increases both its distance from the pole N and the angle S N, which in the position n'' becomes a right angle. A movement towards n'', on the other hand, increases the distance, and decreases the angle. An increase of the acute angle, S N n, increases the momentum of the action of both magnets, whilst a decrease of the same angle has the opposite effect. An increase of the distance diminishes the force with which the poles act upon each other, whilst a decrease augments it. Hence it is evident that the maximum of action occurs in some position between n and n''. The angle n N n', which we will call α, is equal to the deviation of the direction R M from parallelism with N S. Calculation shows that the maximum occurs for a point n', whose position in R M is thereby determined that the angle n N $n' = \frac{1}{3}\ \alpha$. A needle at this point, if sufficiently produced, meets the magnet in N, instead of in N, which is the true pole. The error thus committed can be detected by calculation as soon as α is known. I have, however, preferred to diminish α as far as possible by means of a careful construction, described below.

(*c*.) Suppose the magnetic and geometric axes are in the same plane, but not parallel. If R M is placed parallel with the geometric axis, N S, the magnetic axis, N′ S′, forms with R M (Fig. 6)

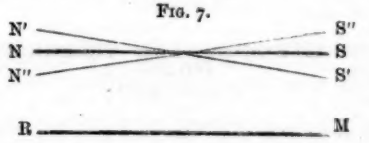
FIG. 6.



an angle β, whose influence upon the result of the measurement has been explained above. In order to eliminate the error arising from the want of coincidence of the magnetic and geometric axis, two observations must be made, one on each side of the magnet, whereby, however, both lines, R M and P Q, must be parallel with the geometric axis, N S. If in the one case the distance of the pole from the extremity of the magnet $= l$, and in the other case $= l'$, the true distance is $\frac{\lambda = l + l'}{2}$. This result follows from the approximately accurate supposition that $l = \lambda + q$, and $l' = \lambda - q$, q standing for the error arising from the deviation of the magnetic from the geometric axis.

(*d*). Suppose the magnetic axis does not lie in the same plane with the direction of displacement of the needle. In this case the horizontal projection of the axis can be taken into calculation, instead of the axis itself. The position of the pole as found for the horizontal projection departs very little from the true position, as the angle formed by the mag-

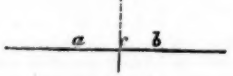
FIG. 7.



netic and the geometric axis is very small. If, *e.g.*, the distance of the poles is 200 m.m., and the angle of the axis 1°, then in the most unfavourable position of the magnetic axis, *i.e.*, when it falls in a plane perpendicular to the geometric axis, the position of the pole, as determined in the horizontal projection, only varies from the true position by 0·1 m.m.

(*e*). If the needle is pointed accurately towards the pole, a considerable displacement of it corresponds to a relatively slight change in the action of the needle upon the magnetic pole, and the position of maximum action cannot be determined with the accuracy desirable. To overcome this obstacle I make two observations, turning the needle alternately right and left from the supposed point of maximum action. Suppose at the beginning of the experiment that the needle is at the point b (Fig. 8), and is now approximated to

FIG. 8.



the position c, where its action upon the N pole is greatest; without stopping at this point, I move the needle onwards to a certain point, a, where it repels the N pole with the same force as in b. If $a\ b$ is trifling in comparison with the distance between both magnets, the middle point of the line, $a\ b$, may be taken as the position where the action of the needle is greatest.

The accuracy of my method depends, among other things, upon the circumstance that the magnetic axis is parallel with the direction of displacement of the needle. Hence it follows that the maximum action between the two magnets cannot be determined by the greatest deviation of the magnet under examination from its original position. Suppose the magnet is in its place before the needle is brought into position; the magnetic

axis of the former will then take the direction of the magnetic meridian. As soon, however, as the needle is fixed up, the former varies from its position, and the pole withdraws from the needle. In order to bring back the magnet to its original position, another magnet, which we may call the compensator, is approached on the side opposite to the needle. Suppose that the needle was at the point *b*: if it is moved from its place, the suspended magnet deviates again from the direction of the meridian. But if the needle is moved further, a new position *a* can be found for it, in which the magnet returns to the meridian. If the compensator remains hereby unmoved, the action of the needle upon the pole of the magnet is the same at *a* and at *b*.

(To be continued.)

EARTH-BORING FOR TELEGRAPH POLES.

By JOHN GAVEY.

THE usual method of digging a post-hole with the pick and spade requires but a brief description. A rectangular opening, averaging 4 feet by 2 feet, is made in the ground, and the earth moved uniformly throughout to a depth of 2 feet 6 inches, whence, by a step-like arrangement, the length of the hole is gradually shortened, until at the bottom it does not exceed 1 foot.

The depth at which it is customary to plant telegraph poles may roughly be considered to vary from 4 feet 6 inches for a pole 24 feet long, to 5 feet 6 inches for one 28 or 30 feet; 6 feet serving up to, say, 40 feet, and 7 feet for any height.

It may be taken, as the result of experience, that the average number of holes which a workman will dig in ten hours is represented in the following table:—

Soil.	No. of Holes per Day. 4 ft. 6 ins. deep.	5 ft. 6 ins. deep.
Clay	6	5
Digging soil ...	5	4
Hard gravel ...	4	3 to 3½

The digging of a pole-hole 4 feet 6 inches deep may be said to involve the removal of 30 cubic feet of soil, which will represent a weight varying from 2850 lbs. to 3600 lbs., according to the nature of the soil; whilst one 5 feet 6 inches deep will contain 44 cubic feet, with a weight of 4180 lbs. to 5280 lbs. This allows for the step-like manner in which such a hole is generally dug.

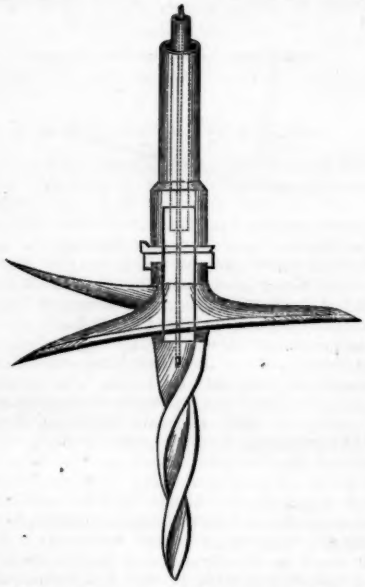
To reduce the great amount of unnecessary labour here involved, the most obvious step is first of all to effect a reduction in the size of the hole. The first instrument invented for carrying out the object was the "Spanish spoon." It consists of a circular metal disc, the chord of the arc forming a cutting edge. The periphery of the disc was provided with a ledge about 2 inches high, to retain whatever might accumulate on its surface, and the whole was fixed at right angles to a long handle.

Various modifications in the form of the spoon have been introduced with more or less success: but the principle of all forms of this apparatus is the same, namely, loosening the soil with a suitable bar, and collecting and raising to the surface the *débris* thus broken away.

* Abstract of a Paper read before the Society of Telegraph Engineers.

The most marked improvement in the method of opening holes for telegraph poles appears to have been the introduction of earth-borers, amongst which may be mentioned those invented by Spiller by Marshall, and by Bohlken.

Spiller's is but a modification, on a large scale, of the ordinary ship's auger; Marshall's and Bohlken's are both constructed on the same principle, but are essentially different from Spiller's. A general idea of their construction can be obtained from the accompanying diagram of Marshall's apparatus.



Spiller's borer the author found to be very effective in sand, clay, and ordinary soil, but ill adapted for gravelly or stony ground. Marshall's borer was very effective in ordinary soil, clay, and gravel.

These borers have obviously one defect: they cannot be worked close to a wall or a hedge, positions where—in road telegraphy especially—it is frequently necessary to erect poles. This difficulty has been overcome by fitting one of the borers with an ordinary ratchet handle, lightening such of the parts as admit of it, and replacing the long tapering point by a shorter one. This modified instrument will bore in clay and ordinary soil, but in gravel it only acts as a spoon, the soil having to be broken up with a bar.

The advantages of these apparatus may be summarised as follows:—

1. Speed: a number of pole-holes can be opened out to a given depth, with the same force of men, in less time than by ordinary methods.
2. Diminution of labour in filling in.
3. Greater solidity of the pole thus erected.
4. Less disturbance and mixing up of the soil,—a point of some consequence in erecting lines of telegraph through private property.
5. The advantage of being able to work in wet soils without baleing or pumping.

No. of Hole.	Time Boring.	Depth. Sand and Loose Soil.	Clay and Marl.	Gravel.	Remarks.
	Mins.	Feet.	Feet.	Feet.	
3	28	—	3·6	2·0	
4	47	3·0	—	2·6	
8	80	—	2·6	3·0	Nos. 7 and 8 bored for A pole, 35 mins. additional taken up for widening both holes.
9	40	0·9	2·9	2·0	
10	58	—	3·6	2·0	Plate broken.
14	63	—	2·9	2·9	Nos. 10, 14, 16, and 18 poles, three men with sheers were told off. The sheers erected for drawing borer, and, when hole complete, used for raising pole. Work done entirely by them.
16	63	—	2·9	2·9	
18	87	—	2·0	3·6	
	466	3·9	19·9	20·6	

6. Saving of expense in sharpening and laying pickaxes.

Amongst the disadvantages may be mentioned:—

1. Strain involved in raising the borers out of heavy soils, with their load of *debris*.
2. The difficulty and—with inexperienced men—danger in rearing the pole into the hole, when the former is very heavy.
3. Liability of the screw-borers to fracture, and additional first cost.

After entering fully into each of these, the author concludes a valuable practical paper by appending several interesting tables, showing results which had been obtained with the borers. From these we extract the one (see above) for Marshall's 12" borer, which has given on the whole the most general satisfaction.

Mr. Gavey added that he had received from Mr. Langdon a letter, in which the writer said that he considered that there was a possibility that, in some soils, the varying strain occasioned by the force of the wind might gradually work the poles out of the ground. Mr. Langdon suggested and described in his letter the addition of a semi-circular iron flange near the bottom of the poles, in order to secure their stability in the ground. He (Mr. Gavey) thought that there was very little danger of the poles being forced up in the manner described. Where the ground was sufficiently solid, the stability of a pole erected in bored holes would be sufficiently great to resist all ordinary pressures. He had that day inspected a length of line which was described in the paper as having been put up in bored holes, and he found that, although the line carried heavy No. 4 wires, the effect of which in ordinary cases was well known, not a single pole had moved, and not a single shilling had been spent on the line, although the gales of three winters had blown over it. That was a very good example of the stability of poles erected in the manner described.

Mr. von Fischer Truenfeld said that, having had some experience with earth-borers, he wished to state a few disadvantages which were not mentioned in the paper. The paper spoke of the greater solidity of poles erected in bored holes; but that supposed that the earth was properly rammed in. He had, however, found that there was a certain difficulty in ramming in the earth. There was always a very small space between the pole and the side of the hole, and in many cases the pole failed to be exactly in the centre, and hence there would be certain places where it would be very difficult to use the rammer. Some soils, too, as, for instance, wet clay, offered very great difficulties to the entrance of the rammer into the narrow space between the pole and the ground. Open spaces would sometimes be left against the side of the pole, and these would become filled up with water, which would tend to destroy the wood. Those defects were not likely to occur if the hole was dug in the ordinary way. The system of boring involved the use of more tools than were required in the ordinary process of digging, and he always thought that it was a disadvantage to use very many tools, especially in countries where long lines had to be erected, as in the interior of Australia or Russia. In the year 1863 he took out earth borers from England for the purpose of erecting a telegraph in the Republic of Paraguay, and he found that the men, who were very good workmen, would rather do the work without the borers than with them, and, in fact, he had to give up the use of the borers, though against his will.

The President (Sir William Thomson) asked what tools the men objected to.

Mr. von Truenfeld said that he used exactly the same sort of borers as those which were then exhibited, though they were not so long.

The President asked whether the men who preferred the pickaxe and shovel were men who were inexperienced with the borer.

Mr. von Truenfeld said that the work was done by soldiers, as the lines were purely military ones. The men were very well trained soldiers, and workmen of the first class. One of the reasons why they objected to the borers was that they had to take too many tools with them. The paper stated that it would be necessary always to carry a pickaxe and shovel, as there were certain places in which the borer could not be used. Consequently the number of tools would be large, and the men found the quantity very disagreeable if they had to travel many miles a day, and shift their tools from place to place. It was important to reduce all the appliances to the very smallest quantity. The men did the work just as quickly with the shovel. He never used shear-legs for erecting the wooden poles, as such an appliance would be an addition to the tools to be carried about. The men lifted the poles by hand, and as they were lowering them into the ground it often happened that a pole would knock the sides of the hole, and a piece of earth would tumble down before the pole reached the bottom, and would prevent the pole from going to its proper depth. He had seen this occurrence repeatedly. He believed that earth-borers of smaller dimensions—for instance, about five inches in diameter—might be advantageously used in erecting provisional military field telegraphs.

Mr. Graves said that some years ago he was under the impression that they might supersede the use of the spade and pickaxe by the introduction of mechanical means which would lessen the labour and lessen the quantity of earth disturbed in erecting poles; and so far as experimental trials went, he should have been justified in speaking quite as highly of the borer as Mr. Gavey had done, and more highly of the Spanish spoon. On one occasion he assembled the chief officers in his own division for a trial near Coventry, on soils of various sorts, and they compared the use of the

borer and the spoon with the ordinary method of making holes with the spade and pickaxe. It was found that, except in the case of rock and hard gravel, the borer showed a decided advantage. Its performances were very clean; the work was done quickly; and it was found possible, with care and under supervision, to lower the poles into the holes without difficulty. But, on the other hand, even in that instance, certain drawbacks developed themselves which afterwards proved a serious obstacle in practice. One was the very great labour attendant on the use of the borer. After a depth of two feet had been reached, every lift became a series of hard continuous work to the men, and there was no relaxation, for the work became a perpetual mill-horse round, followed by a heavy lift, and the deeper they went the harder the work became. It appeared to him that, even on that ground alone, the borer was likely to become an unpopular instrument with the men. His experience had been that when they tried a test experiment under the supervision of superior officers who were interested in bringing out the best theoretical result, they generally got something which the practical use of the same instrument by workmen under ordinary conditions, did not confirm. He had distributed the borer and the spoon throughout the various gangs working in parts of the country with which he was connected, and had asked for reports as to their success. During the first month or two the officers reported very favourably of both the new instruments, but, on the whole, more in favour of the spoon-than of the borer; but he had found that in the course of six months, except in a few special instances, the whole of the novelties had quietly dropped out of use. They had been reported upon, and then ceased to be employed. In spite of the manifest advantages of the borer, a large space of ground had to be traversed while it was being used, and thus crops might be injured to a large extent, and there was a difficulty in working the instrument except in open spaces. A large portion of the work for the Post Office had to be done close to the bottoms of hedges, or the banks of canals, and in either instance it would be impossible to work the instrument. The Spanish spoon, so far from being abandoned, was the only mechanical instrument which, in his division of the postal service, could be said to have any vitality. His staff had made many modifications in the shape of the spoon, but the general result was that it could be worked in a limited space where they could not obtain room for the use of even the ordinary spade and pickaxe. In loam or clay, where the borer could cut easily, the difficulty lay in lifting the earth when cut; and in those cases in which there was hard gravel or soft rock, the borer, for all practical purposes, became a spoon, as the soil had to be smashed first, and then lifted. Such a process of lifting, however, could be more easily and more rapidly effected by the use of the spoon. In erecting a road line of forty miles from Birmingham to Derby, he had arranged that the work should be done, as far as possible, with spoons; and amongst a gang of thirty men there were only three spades, and the whole of the line was erected by the use of the spoon, under two foremen of competent experience, and the result was so far satisfactory that the cost for labour was not on the average greater than would have been occasioned by the use of pick and spade; and there was an absolute gain in the fact that the earth was not removed to so great an extent. But beyond that he was bound to say that the economical gain was absolutely nil. The advantage gained in labour by a smaller quantity of earth having to be removed was lost by the increased labour of fixing the poles; and when the poles were heavy, a large number of men had to be collected, at short intervals, from their other employments, in order to set the poles into the holes; and in many cases it happened that the sides of the hole were broken, and the holes were half filled up, so that they had to be spooned out again. He might add that, although this result, which was so far satisfactory that it did not cost more than the erection of poles in the ordinary manner, was obtained by a large gang working under competent supervision, he did not find that it was practicable to enforce the use of any substitute for the spade in the the case of a few men working by themselves. The workmen instinctively clung to the spade, and his experience coincided with that gained by Mr. von Truenfeld in Paraguay. He believed that neither the spoon nor the borer was used in his division to any appreciable extent.

Mr. Bell said that he thought that Mr. Gavey, in referring to the old method, had given rather a bad case as to the quantity of earth which it was necessary to remove. He had given a measurement of two feet, but he (Mr. Bell) thought that one foot six inches was ample space for a man to work in. There was one point upon which it was necessary to have a little information. In the drawing of the A pole the curves were shown, and it was apparently assumed that the friction of the earth upon the pole was such that, when the pole was canted over under strain, the earth would be caused to move in the direction which was shown. He wished to know whether that point had been really subjected to any test, for, unless the pole had a very considerable taper at the bottom, he did not think that the earth would have such a hold upon it as to avoid its being canted over. It was, however, clear that, in the case of such a small base, and the height of the pole being so much greater in proportion, when a strain came upon the pole one leg would go down slightly into the soft earth, and the other leg would be lifted, if there was no sill-piece or tie such as was shown in another diagram. He thought that Mr. Langdon, in his letter, had pointed out rather a weak point, and that it was necessary to adopt something of the kind which he had recommended, in order to give the poles a good hold of the soil.

The President—It seems to me that the resistance to tilting over in the case represented in Fig. 7 would depend solely upon the force required to pull either pole directly up.

Mr. Bell concurred, and said that it seemed that the resistance depended upon the friction of the earth against the pole. Unless there was a very considerable friction, which they could scarcely imagine would be obtained by mere ramming, an excessive strain would certainly draw one foot up and depress the other, according to the softness of the soil.

Mr. Burton, Director of Telegraphs in the Argentine Republic, said that what Mr. Truenfeld had said with respect to the falling down of earth was a matter of fact, and it would be a disadvantage either to have the pole higher than it ought to be in the ground, or to have to take the pole out of the ground in order to remove the earth which had fallen under it. It should be considered also that in other countries they were unable, as a rule, to obtain poles in the same form as we had them in England. For example, he had about 30,000 wooden poles on his line, and out of any hundred poles it would be impossible to find five which were straight, and in such a case the borers would be practically useless. If the holes were bored of sufficiently large dimensions to receive such poles, the ramming down would be a matter of serious difficulty, and would leave cavities which would be filled up by water; or, if the poles were not injured in this way, they would get loose, and men would have to be continually employed in putting them straight, especially on curved portions of the line.

Mr. W. H. Preece asked Mr. Burton what was the nature of the wood used in the Argentine Republic.

Mr. Burton replied that, as a rule, the wood was of

a very hard kind. There were two kinds which were generally used. One was Algaroba, and the other was Quebracho Colorado. It was somewhat difficult for a man who was not well accustomed to the colour of the wood to distinguish between Quebracho Colorado and Quebracho Blanco. The Quebracho Blanco was a wood which would not last above one-third of the time the Colorado would last, and consequently any cavities which might be left in the ground by imperfect ramming would materially affect the durability of the Quebraco Blanco.

Mr. PREECE asked what the life of a pole was considered to be in the Argentine Republic.

Mr. BURTON said that, from his experience, he should think that, if the best kind of wood was used, the poles could be left for fifty years in either a perpendicular or a horizontal position, without suffering any deterioration whatever. The wood was so heavy that it could not be got in the capital of the Republic except to a very slight extent, as the cost of transport was very great, and the roads were as yet in a most primitive condition, and there were no railways to the interior. It was cheaper to use wood obtained from either Europe or the United States. This timber was abundant in the northern provinces, forming forests of a hundred miles or more in extent, with but small intervals between them. The wood itself was very cheap, and at the commencement of the construction of the telegraph the poles could be bought for about ten shillings each, but the proprietors, in consequence of the demand, had raised the price to about thirty shillings a pole. He had no idea of the age of the trees from which the poles were cut. The trees grew along the river coast, but it was perfectly useless to attempt to bring them down to Buenos Ayres, as the carriage by water was very expensive, and the wood sank if it was formed into a raft.

The PRESIDENT asked whether they were to understand that no form of borer had been found suitable for telegraph work in the Argentine Republic.

Mr. BURTON replied that a borer had been used by one contractor, but he found it useless in consequence of the irregular form of the tree, and, in addition, there was the objection of which Mr. Truenfeld had spoken, namely, the dislike of the men to carrying many tools. He (Mr. Burton) had had to dispense with many of the tools for maintenance which would be used in England and other countries where transport was easy. The men had always to go on horseback, and travel very great distances every day.

Major MALCOLM said that Mr. Truenfeld had suggested that the borers would be very useful for military telegraphs. He should like to ask whether that gentleman had himself tried the smaller borer for such work. One objection to the small borers would be that the V-shaped opening, being small, would get jammed up with stones, and the borer would have to be perpetually pulled up from the ground in order to be cleared. Another objection was that, in his experience, he had found that, owing to some manufacturing defect, the borers broke in the pipe.

Mr. VON TRUENFELD stated that the borers which he used in Paraguay were about five inches in diameter, and they were much shorter and stronger than those exhibited at the meeting. Their length was about four feet. He used them for boring holes about three feet deep, and the poles were made of a tree of a very good round shape. The soil in which the poles were fixed consisted chiefly of clay and sand.

Mr. CULLEY said that three years ago he gave very great attention to the question of boring, for he thought, and indeed many others thought, that very great advantage would arise from the use of boring tools. He caused tools to be sent through the country, and experiments were made in many places. After the experiments had been made for some time, he called for reports, and many of the reports which he had received treated the question in the most practical and precise way. The report from Nottingham spoke of Marshall's borer, and the writer said, "In clay, two men bored one hole, five feet six inches deep, in thirteen minutes, with fourteen lifts." This meant that the borer was lifted from the ground fourteen times. The lifting was the most difficult part of the work. The borer was screwed four inches into the ground, and the men had to put their arms under the cross bar, and lift the tool bodily out. The report from Doncaster said, "Where the earth is loose or soft, good progress may be made with the borer, but where the ground is harder the borer becomes almost useless, and the use of the borer and spoons only becomes more slow than the ordinary process of digging. With either the spoon or the borer all large stones have to be broken up before they can be drawn out, while in the ordinary way they are easily got out by digging." He had received reports from Ireland, from which the general conclusion appeared to be that, where the soil was of such a nature that spoons could be used, such tools were very much to be preferred to the pick and shovel; but the cases were so many in which the pick and shovel must necessarily be used, that it seemed doubtful whether it was advisable to carry double sets of tools with all the gangs, for the pick and shovel would of course answer for every purpose, while the Spanish spoon alone would not. In Ireland the borer had not been tried. He had recently made enquiries throughout the country as to whether the use of either the borer or the spoon had survived, and he found that they were not used anywhere. There was a report from Newark from which it appeared that Marshall's borer and the spoon were both good tools in certain grounds, but they both required a "knack" or experience in working, and that being the case, their use could be profitably brought about only where the same workmen are employed continuously. There was no doubt that in introducing any new tool, there was an immense amount of *vis inertiæ* to contend with, and the borer and the spoon, very probably, had had to contend with that disadvantage. This obstacle had impeded the introduction of pulley-blocks for straining up the wires, but it had at length been overcome, and now there was not a single wireman who would not require a set of pulley-blocks before he set to work. When the deputation from the American Western Union Company was over in this country, he enquired of the general superintendent as to the use of the borer, and the reply was that he, at any rate, never used the pick and shovel at all for fixing poles. No doubt the difficulty arising from the earth being pushed down into the hole by the butt of the pole could be met by special apparatus, in the form of a tub or tube, made to fit in the upper part of the hole, but all such things would have to be carried with the men, and the same apparatus would not fit every hole, and hence there might be an inconvenient multiplicity of appliances. It did not appear to him that the punning up of the pole formed any insurmountable objection. Mr. von Truenfeld had said that there was no room in the hole for punning, but by using a punner with an end somewhat curved, so as to fit the circumference of the pole, that difficulty was met, and they could pun very well in a width of two inches or two inches and a half. But the great difficulty, after all, in using boring tools was that men had to be trained in their use, while labourers accustomed to the use of the pick and spade could be met with in any part of the country, and set to work directly. He hoped, however, that they would not give up the trial of these tools; but he must confess that he had very much less hope of their being ultimately successful than he had three years ago.

Mr. GOLSTONE said that some time ago he was so satisfied with some experiments which had been made

with the borers that he gave them into the hands of a foreman to construct a line of poles by the side of a railway. The work proceeded very well while the men were working on level ground, but the borers were found to be utterly useless when they came to the side of any bank in which the ground had been disturbed, whether the bank sloped down from the line or formed the side of a cutting. It would be necessary, in devising borers, to make something of universal application, if such tools were to be successful. Railways were particularly interested in this question. In many cases banks were made of new tipping, and the soil was placed very lightly, so that it was difficult to fix poles in such places. An effective borer would save a great deal of trouble in such cases.

Mr. GAVEY, in reply, said that one of the objections which had been raised to the use of borers was the number of tools which the men had to carry. He quite admitted that, if the spade and pickaxes, and a variety of other tools as well as borers, would have to be carried, it might be necessary to abandon the use of the borers. But in a country like England the officer in charge of the line generally knew the character of the soil on which the line was to be erected, and he could act accordingly. If the use of the borer was inadmissible on any particular soil the holes could be made with other tools. A great point had been made as to the small space which existed between the pole and the ground, and the want of room for ramming. He had always considered that the smallness of the space which existed between the pole and the ground was one of the great advantages of a bored hole. Something had been said as to the use of borers abroad, but in dealing with the subject he had referred more to their use at home, where, as he had said, the officer in charge could use his own discretion as to the tools which would suit the soil. In foreign countries it might, of course, be advisable for the officers to rely only upon such tools as they knew could be used under all circumstances. With reference to Mr. Graves's remarks, he (Mr. Gavey) was not aware whether Mr. Graves had used the small modified instrument which was referred to in the paper as Marshall's spoon. That was an instrument which was well adapted to overcome many of the objections which had been raised to the borer itself. It was quite true that, with a heavy borer, the men were unable to open an hole near a wall or an embankment, or in a confined space, but, with the small ratchet borer which he had referred to in the paper, that difficulty was thoroughly overcome. That instrument would bore very fairly in clay and in light soils. In heavier soils it might be used only as a spoon, as the soil had to be broken up; but it had certainly been his opinion—and he ventured to say that it was his opinion still—that with that instrument they could collect the soil more readily than they could with the Spanish spoon. With regard to diagram No. 7, he understood from Mr. Bell that it was that gentleman's opinion that the only hold which the soil had on the pole was the friction between the surface of the pole and the soil itself. That would be so if the pole was raised vertically out of the ground by means of shears, but he did not think that that was the kind of action which would occur. Of course if the poles were not rigid they would bend, and under such circumstances they would be drawn out, and would simply be held by the friction existing between the poles and the soil; but he scarcely thought it was a correct view of the case that such a condition would exist. With reference to the general use of borers he thought that there was, no doubt, difficulty, as had been said by several speakers, and one of the greatest objections to the use of the borer was certainly the difficulty in withdrawing it from the soil. The second great objection was the difficulty in rearing the pole into the hole. But those difficulties were very fairly met by the means which he had described, and he did not think that the additional weight, in the shape of tools that had to be carried, by adding a pair of light shears to each gang was worth much consideration. He believed that one of the causes which had led men to object to the use of borers was the physical strain which was involved in raising the instrument out of the ground; but if that strain was removed by some simple means, such as shears and a pair of blocks, the objections would very soon vanish. He had found no difficulty in getting the men to do the work with borers when they were provided with the means of avoiding the great physical strain to which they would be otherwise exposed. One erection of the shears served for the whole operation with regard to each pole. He had found no difficulty in lowering the pole without knocking the earth from the sides of the hole, and so partly filling it up. But certainly any such contingency could be provided for by making the hole six or eight inches deeper than the height of the pole required it to be.

The PRESIDENT, in closing the discussion, said—I wish to make just one remark upon diagram No. 7. The disadvantage of the method in No. 6, as I understand it, is the large quantity of loosened soil that it involves. The advantage it presents is the presence of the cross-bar, which cannot move upwards without dragging a large quantity of soil with it. But on referring to diagram No. 7 I think that, notwithstanding the comparatively small quantity of soil loosened in the process of executing it, we have an arrangement which could not possibly be advantageous, even with the addition of ratchets projecting out as in the additional (not numbered) diagram before us. It appears to me that in diagram No. 7 we have a mechanical arrangement devised, as it were, for the purpose of plucking out one or other of the poles. As the arrangement is described in the paper, it is stated that if the fulcrum were B, the lines of motion would be those shown by the full curves; or if the fulcrum were D, the lines of motion would be those indicated by the dotted curves. Probably in the actual case the virtual fulcrum would be somewhere between the two—B and D. The line of motion then of the middle of the immersed part of the pole C would be vertically upwards. There would be a slight obliquity to the right in the motion of the upper end of the part immersed, and a slight obliquity to the left in the motion of the lower part; but those obliquities would be so slight that it would take a very solid surrounding to give any very considerable resistance to the motions. It seems to me that after being tried for a time by severe forces pulling in the direction of the arrow-head in the diagram, the left-hand pole would become loose, and would then have only its own weight with which to give stability to the structure; and as the same thing might happen to the other pole by forces in the other direction, the whole is, in point of fact, an arrangement as if devised in the first place to lessen the hold of each pole upon the earth, and afterwards to pluck out one or other, according to the direction of the final pull. It is easy to reckon how much stability will be given by weight, and I believe the virtual stability of this arrangement will be that of two loose poles standing simply by their own weight. I suspect that in truth there would be less resistance in the case of the two poles rigidly connected, as shown in the diagram, than there would be if they were quite independent, with merely a loose link at the top, to give a resistance equal to the sum of the resistance of the two poles separately. I think it very probable that, even taking into account the assistance which gravity would give, it would be found that the particular arrangement shown in the diagram would have more power of resistance to a force applied at the top in a direction perpendicular to the plane of the diagram than

to a force in the direction shown by the arrow-head.

In reply to Mr. Culley,

The PRESIDENT further said—If the force was always in one direction, then there would be nothing to loosen the pole B A. The pole B A would give its full resistance. I think that if there were forces sometimes in the one direction and sometimes in the other, it is even possible that there would be less resistance with the two poles than from the one alone, from the fact that the pole A C would get loosened by forces acting in the direction of the arrow-head. It seems to me that after both poles become loosened, the resistance might be less than with a single pole. If the force is always in one direction (as that shown by the arrow-head), then, with the poles loosely joined at the top, the resistance would be greater undoubtedly than with a single pole; but probably not quite so much greater as double. Although that is not a good arrangement, it would be better than the arrangement shown in the diagram. I think that if the poles were close side by side, there would be less than double the resistance of one pole, because the whole amount of the resistance of the earth that one pole would experience would be diminished by the presence of the other. If the two were placed at a considerable distance from one another, and if they were not coupled so as to give the leverage action upon which I have commented, then the force would still be not quite equal to the sum of the two because the whole force could be distributed exactly on the two poles in proportion to their maximum resistances. The leverage action in the ordinary hammer fork for drawing nails is almost precisely the same in principle as that which I have indicated in this case. I have listened with very great interest both to Mr. Gavey's paper and to the comments, and also to the general information with which other speakers have followed it up. Although it is quite clear that in distant countries, and in a variety of soils, and in circumstances in which division of labour, and minute subdivision of appliances are not available, the method of making holes by the pick and spade is that upon which most reliance must be placed. Still I think that Mr. Gavey has made out an exceedingly good case for the borer in a very large class of applications. What Mr. Culley has said with reference to the trials that have been made shows that there is a large province still left for the borer. It must be remembered that the method is comparatively new, having been in use only a few years; and when so much can be said in its favour as Mr. Culley has said, and as has been brought forward in the paper, I think we must agree that it is a very important appliance. In a large district of country, over which a great many lines of telegraph may have to be taken, and where the soil is generally of a suitable character, the borer will be of considerable value. There can be no doubt whatever of the figures which Mr. Gavey has put before us, and they show a very great increase in the quantity of work done by the labour of a certain number of men through the use of the borer in favourable circumstances. The advantage of bringing forward and describing new appliances before this society is well illustrated by the interesting information and new ideas which we have received from Mr. Gavey himself, and the light which has been thrown on the subject by the different speakers. I propose a cordial vote of thanks to Mr. Gavey for his paper.

The London Stock Exchange is about to be placed in direct telegraphic communication with the Paris Bourse, and the new telegraph station in Paris has just been inspected by the officials of the Submarine Telegraph Company.

Notes.

THE new Postmaster-General for the United States, Mr. Jewell, has himself been a practical telegrapher, and a successful business man. He has spent much time in Europe examining the working of the various postal systems. It will be interesting to observe the course he takes on the telegraph question, for his predecessor and President Grant have both urged on Congress the establishment of an American Postal Telegraph system. The proposal, however, met with the most strenuous and successful opposition. Mr. Jewell reports himself as opposed to having the Department go outside of its legitimate functions, and by inference is opposed to the Postal Telegraph system.

We have much pleasure in announcing the fact that Messrs. Siemens have appointed Mr. F. C. Webb (Memb. Inst. C.E. and Soc. T.E.) to succeed the lamented Mr. Ricketts, in charge of the submersion and repair of their cables on the South American coast. Mr. Webb's experience in this particular branch of the profession is perhaps more continuous and extensive than that of any living engineer.

The Queen, who has felt the deepest sympathy for the sufferers by the wreck of the *La Plata*, directed inquiries to be made after the widow of Capt. Dudden, the commander of the vessel. Under present circumstances it is impossible to communicate this expression of Her Majesty's sympathy to Mrs. Dudden. She was married less than twelve months ago, and has just been confined. The news of the loss of the ship and the death of her husband has hitherto been withheld from her, and she will not be told of them until after her recovery. She will at the same time be informed of the admiration Her Majesty feels for the courage displayed by her late husband. The owners and charterers of the *La Plata* have expressed their intention to provide for the support of Mrs. Dudden, should such assistance be necessary. Capt. Palmer, of Her Majesty's ship *Fisgard*, in reply to a question put to him by Messrs. Siemens, has written as follows:—"'Rope Yarn's' letter in *The Times* of December 12 is utterly false with regard to any remark of mine. I never saw the *La Plata* to my recollection, and am not, therefore, likely to have made any remark on her state." Moreover, the *La Plata* never passed the *Fisgard* at all. Messrs. Siemens Brothers state that the dead-weight capacity of the *La Plata* was 1656 tons, and that she had taken on board 184 nautical miles of cable, weighing 765 tons when wet, besides land line materials, 79 tons; buoys, chains, ropes, &c., 55 tons; and machinery, 36 tons; making a total of 935 tons, thus leaving a capacity for coal of 721 tons. They add that—although it would have been greatly to their advantage to save both the delay and the expense involved in coaling at foreign stations, only 266 tons of these 721 tons of coal were placed on board,—the amount, according to Capt. Dudden's opinion, calculated to put the ship in the best possible trim for a voyage during rough weather across the Bay of Biscay.

Upwards of 1200 telegrams, or an average of more than 200 a day, were disposed of in the travelling telegraph office which was stationed in the centre of the Agricultural Hall during the

recent Smithfield Club Cattle Show. On two successive days upwards of 250 telegrams were forwarded and received, and the total number dealt with in the week represents one telegram for every hundred persons who visited the Show. As many as 5000 letters and newspapers were also posted at and delivered from this office during the week. The telegraph van is one of the most useful and successful introductions of Mr. Scudamore.

Telegraphists must have seen with pleasure the effective aid which telegraphy has given to those astronomers who have undertaken to observe the transit of Venus. Practically the whole earth has been made one huge observatory. By its means stations have been selected, longitudes determined, results recorded, and we now know exactly where success has been obtained and where failure has attended the zealous observers. The telegraph has enabled the world of Science to congratulate itself upon a grand triumph.

Electrical Science in English and Foreign Journals.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, Vol. lxxix., No. 21. November 23, 1874.

On Fresh Improvements upon Magneto-Electric Machines.—Z. T. Gramme.—Compared with his model of 1872 his new model for this year possesses many advantages. This galvanoplastic machine has now only one central ring instead of two, and two bar electro-magnets instead of four. Its weight is 177 kilogrms., that of the copper ring and the electro-magnet bars being 47 kilogrms. The dimensions are—0·55 m. wide, 0·60 m. high. In comparison with his 1872 model this last one possesses the following advantages:—(1.) Half the size. (2.) Three-quarters the weight. (3.) The copper used in its construction reduced to three-quarters. (4.) The motive force necessary to work it is much reduced. These improvements are obtained by the suppression of the exciting bobbin; by putting the electro-magnet in the circuit itself of the current; by a better arrangement of the copper portions of the electro-magnet bars; and by a slight increase of speed. "The electro-magnet setting, which I used to make with round wire, is now formed of a band of thin copper half the width of a bar magnet. The arrangement of putting the electro-magnet in the circuit has given rise to a change of pole, which I have been obliged to cancel. When the machines are in motion, and the circuit closed by metallic baths, the poles remain the same; but as soon as a catch or a stoppage takes place, accidentally or by design, the poles change, so that if the machine be again put in motion without re-arranging the conductors an *inverse* work will be performed. For example, instead of silver-plating the objects for the bath, they will be unsilvered. To obviate this inconvenience I cause the current to be cut off automatically as soon as the machine slackens, and thus avoid secondary currents, which alone occasion these polar reversals. Similar improvements in construction, and very considerable reductions in weight and size, have also been effected in electro-magnetic lighting machines, whether for lighting gas-lights or lighthouses."

No. 22. November 30, 1874.

Quite void of any papers touching on electrical, magnetic, or telegraphic subjects.

Les Mondes, Vol. xxxv., No. 13. November 26, 1874.

The Pneumatic Telegraph: a Way to Discover where Carriers are when Stopped in the Tube.—M. Pouchet, in the *Revue Scientifique du Siecle*, says:—Although this accident is exceedingly rare, yet the possibility of its happening at all necessitates the discovery of a ready means for localising the position of the arrested carrier. The method hitherto employed has not given good results. It is to apply to the mouth of the pneumatic tube a receptacle full of compressed air of a known pressure, which is allowed to enter the tube. The resultant pressure in the receptacle and the tube as far as the arrested carrier furnishes datum to estimate the carrier's distance. The distances so measured have not even been approximately correct. M. Ch. Bontemps adopts another method based on the, law of the propagation of sound-waves in pipes. He fits to the mouth of the pneumatic tube a kind of drum,—an instrument furnished with an elastic membrane whose inflations or depressions are automatically registered upon a revolving cylinder. A diapason likewise traces, upon the same cylinder, seconds and fractions of a second. The under part of the membrane is set in motion by an explosion, say that of a pistol. The blow raises the membrane, and its upward motion is at once registered. The wave speeds onwards along the tube with the speed of 330 metres a second, and strikes against the obstacle; thence it is reflected back to the membrane, and a second motion is registered. It now only remains to calculate the exact time between the two registers, representing twice the time the wave takes to traverse the distance from the tube's mouth to the obstacle. This arrangement is said to be so exact that the possible error does not exceed 2 metres.

Nos. 14 and 15. December 3 and 10, 1874.

Nothing is published in these numbers suited to our readers, except what we have already translated from other scientific journals.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. December, 1874.

Description of MM. Voisin and Dronier's Electro-Catalytic Lamp-Lighter.—A full description of this apparatus was sent to us by the Count du Moncel, and appeared in our number for last June, page 225.

Annales Telegraphiques. Third Series.

This is the reappearance of an old and well-known serial. The first numbers were issued in 1855, by the late M. Emile Saigey, then Inspector of the telegraph lines, and after a short life of eight months the publication was discontinued. In 1858 it was resuscitated, under the superintendence of a Committee, soon to suffer another interruption towards the end of 1865. For the third time the publication is now re-commenced as a *third* series.

To Correspondents.

MR. CHARLES B. SHARPE's communication respecting the invention of the Electric Telegraph is not in such a form as to enable us to publish it His statements must be supported by printed and published evidence.

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